

CHROMOSOME NUMBERS FOR  
EUPHORBIA (EUPHORBIACEAE)  
FROM WESTERN NORTH AMERICA

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*Euphorbia* L. has undergone much evolutionary diversification in western North America. Until the study of Urbatsch et al. (1975), practically no information was available on the role played by aneuploid and euploid changes in chromosome number in the evolution of American Euphorbias. Perusal of reports by Hans (1973) and Urbatsch et al. (1975) reveals that many taxa remain cytologically unknown, particularly in the southwestern United States and northern Mexico.

METHODS

Immature cyathia were killed and fixed in the field in modified Carnoy's fixative (4-6 chloroform: 3 ethanol: 1 glacial acetic acid, v:v) and were stained for 24 to 48 hours in iron-acetocarmine. Anthers were squashed in Hoyer's solution according to the methods of Beeks (1955). Chromosome counts were determined from meiotic microsporocytes, and camera lucida drawings were prepared to document the reports. Vouchers are at ASU.

RESULTS

Twenty-seven counts representing sixteen taxa were made (Table 1). First reports are presented here for nine species and one variety, and previously unreported chromosome numbers are documented for two additional taxa (figs. 1-15).

DISCUSSION

Considerable aneuploid and euploid variation is present among the taxa sampled in subg. *Chamaesyce*. Hans (1973) suggested that the base number for *Euphorbia* as a whole is  $x = 7$ , and Urbatsch et al. (1975) indicated a suspected base number of  $x = 7$  for subg. *Chamaesyce*. If  $x = 7$  is the base number for subg. *Chamaesyce*, then numbers of  $n = 6$ , 8, and 9 are probably aneuploid changes from that base. This was suggested for *Euphorbia* as a whole by Hans (1973).

Hans (1973) indicated that  $n = 13$  is an unusual chromosome number in *Euphorbia*. Presence of this number in several taxa of subg. *Chamaesyce* may represent aneuploid change from a tetraploid number of either  $n = 12$  or  $n = 14$  or a direct amphidiploid from a hybrid between

TABLE 1. CHROMOSOME COUNTS FOR TAXA OF EUPHORBIA. <sup>a</sup> = first report for this taxon; <sup>b</sup> = previously unpublished number for this taxon; <sup>c</sup> = some cells with 12 II + 2 I.

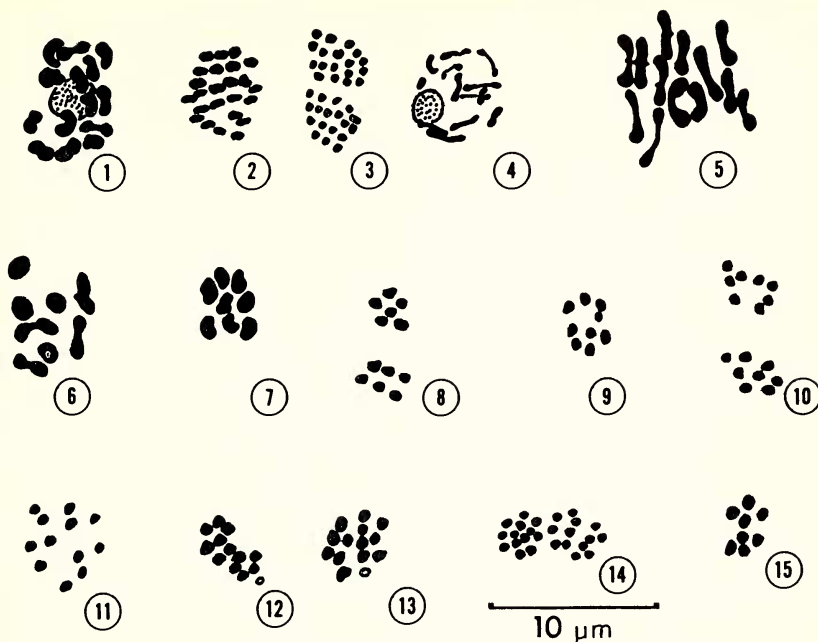
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Subg. <i>Agaloma</i> (Raf.) House	
<i>E. plicata</i> S. Wats. <sup>a</sup>	Sonora, E of Mazatán, <i>Lehto</i> 19342, $2n = 14$ II (fig. 1).
Subg. <i>Chamaesyce</i> Raf.	
<i>E. albomarginata</i> T. & G.	Sinaloa, N of Los Mochis, <i>Lehto</i> 19518, $2n = 24$ II <sup>b</sup> (fig. 2). Arizona, Pima Co., 2 mi W of Robles, <i>Keil</i> 11152, $n = 18$ I/ pole (fig. 3). New Mexico, Socorro Co., 12 mi E of Río Grande on US 60, <i>Keil</i> 10740, $2n =$ ca. 24 II.
<i>E. arizonica</i> Engelm. <sup>a</sup>	Arizona, Maricopa Co., White Tank Mts. Regional Park, <i>Keil</i> 11172, $2n = 13$ II (fig. 4); Pima Co., Organ Pipe Cactus Natl. Mon., <i>Lehto</i> 19231, $2n = 13$ II.
<i>E. capitellata</i> Engelm. <sup>a</sup>	Arizona, Maricopa Co., McDowell Mts. Regional Park, <i>Lane</i> 1789, $2n = 13$ II <sup>c</sup> (fig. 5).
<i>E. fendleri</i> T. & G. var. <i>fendleri</i> .	New Mexico, Rio Arriba Co., 14 mi N of Espanola, <i>Keil</i> 10714, $2n = 14$ II.
<i>E. florida</i> Engelm. <sup>a</sup>	Sonora, 8 mi N of Hermosillo, <i>Lehto</i> 19345a, $2n = 8$ II. Arizona, Pima Co., just W of Quijotoa, <i>Keil</i> 11003, $2n = 8$ II (fig. 6); 3 mi N of Santa Cruz Co. line on I-19, <i>Keil</i> 11085A, $2n = 8$ II.
<i>E. hirta</i> L. var. <i>hirta</i> .	Sinaloa, 18 mi NE of Choix, <i>Lehto</i> 19553A, $n = 8$ I/ pole (fig. 7).
<i>E. hyssopifolia</i> L. <sup>a</sup>	Arizona, Santa Cruz Co., 7 mi W of I-19 on Ruby Rd. <i>Keil</i> 11053, $2n = 6$ II; just off I-19 on Ruby Rd., <i>Keil</i> 11096, $n = 6$ I/ pole (fig. 8).
<i>E. indivisa</i> (Engelm.) Tidestr. <sup>a</sup>	Sonora, 10 mi NE of Imuris, <i>Lehto</i> 19381, $2n = 9$ II (fig. 9).
<i>E. lata</i> Engelm.	New Mexico, Socorro Co., 12 mi E of Río Grande on US 60, <i>Keil</i> 10741, $2n = 28$ II.
<i>E. melanadenia</i> Torr. <sup>a</sup>	Arizona, Maricopa Co., McDowell Mts. Regional Park, <i>Lane</i> 1789, $n = 8$ I/ pole (fig. 10).
<i>E. pediculifera</i> Engelm. <sup>a</sup>	Sonora, 21 mi W of Sonoita, <i>Lehto</i> 19237, $2n = 12$ II + 1 I (fig. 12). Arizona, Santa Cruz Co., Pena Blanca Lake, <i>Keil</i> 11010, $2n = 12$ II (fig. 11); 5.5 mi W of I-19 on Ruby Rd, <i>Keil</i> 11039, $2n = 13$ II + 1 I (fig. 13).
<i>E. polycarpa</i> Benth. var. <i>hirtella</i> Boiss.	Sonora, 8 mi N of Hermosillo, <i>Lehto</i> 19358, $2n = 13$ II.
<i>E. polycarpa</i> Benth. var. <i>polycarpa</i> <sup>a</sup> .	Arizona, Maricopa Co., McDowell Mts. Regional Park, <i>Lane</i> 1790, $n = 13$ I/ pole (fig. 14).
<i>E. setiloba</i> Engelm. <sup>a</sup>	Sonora, 20 mi E of Altar, <i>Lehto</i> 19282, $2n = 8$ II (fig. 15); 8 mi N of Hermosillo, <i>Lehto</i> 19359, $2n = 8$ II. Arizona, Maricopa Co., McDowell Mts. Regional Park, <i>Lane</i> 1788, $2n = 8$ II.
Subg. <i>Poinsettia</i> (Graham) House	
<i>E. eriantha</i> Benth.	Sonora, 8 mi N of Hermosillo, <i>Lehto</i> 19357, $2n = 14$ II. Arizona, Maricopa Co., White Tank Mts. Regional Park, <i>Keil</i> 11177, $2n = 14$ II.

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$n = 6$  and  $n = 7$  parent taxa. An aneuploid origin for  $n = 13$  plants is favored by my reports of  $2n = 12$  II,  $2n = 12$  II + 1 I, and  $2n = 13$  II + 1 I for *E. pediculifera*.

*Euphorbia albomarginata* was reported by Urbatsch et al. (1975) to have  $n = 12$ . My reports of  $n = 18$  and  $n = 24$  for this taxon indicate that it comprises several polyploid races with a base of  $x = 6$ . Further investigation should be undertaken to determine whether the different



FIGS. 1-15. Camera lucida drawings of *Euphorbia* chromosomes. See Table 1 for interpretation and voucher citation. 1. *E. plicata*, diakinesis. 2. *E. albomarginata*, metaphase I. 3. *E. albomarginata*, anaphase I. 4. *E. arizonica*, diakinesis. 5. *E. capitellata*, metaphase I (superimposed chromosomes moved for clarity). 6. *E. florida*, diakinesis. 7. *E. hirta* var. *hirta*, metaphase II (only one half of cell shown). 8. *E. hyssopifolia*, metaphase II. 9. *E. indivisa*, metaphase I. 10. *E. melanadenia*, anaphase I. 11. *E. pediculifera*, metaphase I. 12. *E. pediculifera*, metaphase I. 13. *E. pediculifera*, metaphase I. 14. *E. polycarpa*, anaphase I. 15. *E. setiloba*, metaphase I.

cytotypes represent morphologically or geographically distinguishable races. Populations of *E. albomarginata* should be checked to determine whether there are any extant diploids.

*Euphorbia arizonica* and *E. setiloba* are similar in many respects and were considered by Wheeler (1941) to be closely related. My chromosome counts for these taxa,  $n = 13$  and  $n = 8$  respectively, indicate a considerable cytological hiatus between the two. This gap is similar to that reported by Johnston and Turner (1962) and Strother (1969) for closely related plants in *Dyssodia* (Compositae), also  $n = 8$  and  $n = 13$ . A satisfactory explanation for such a gap is not yet available in either case.

My report of  $n = 8$  for *E. hirta* var. *hirta* differs from previous reports for this species. Hans (1973) summarized reports for *E. hirta* published by Indian workers ( $n = 9$ ,  $2n = 20$ ,  $2n = 12$ ). The name, *Euphorbia hirta*, has been misapplied in some cases to plants now known correctly

as *E. pilulifera* L. (Wheeler, 1941). Since *E. hirta* is a very widespread taxon and has become established as a weed in many regions, it is not unreasonable to suspect that it may have undergone localized aneuploidy. Before such an explanation is accepted, however, identity of plants from which previous reports were made needs to be checked. If the various reports do, indeed, all apply to the same taxon as currently recognized, the systematics and evolution within this group would make an interesting topic for future work.

The great variety of chromosome numbers in *Euphorbia* subg. *Chamaesyce* in North America is indicative of the very significant role that chromosomal changes have had in the evolution of these taxa. More reports from additional taxa and from additional populations will be needed before evolutionary relationships in subg. *Chamaesyce* can be satisfactorily elucidated.

#### ACKNOWLEDGMENTS

I thank Ms. Meredith Lane and Mrs. Elinor Lehto for collecting plant material for this study. I am particularly grateful to Dr. Donald J. Pinkava for providing laboratory facilities for this investigation and for reviewing my manuscript.

#### LITERATURE CITED

- BEEKS, R. M. 1955. Improvements in the squash technique for plant chromosomes. *Aliso* 3:131-134.
- HANS, A. S. 1973. Chromosomal conspectus of the Euphorbiaceae. *Taxon* 22:591-636.
- JOHNSTON, M. C. and B. L. TURNER. 1962. Chromosome numbers of *Dyssodia* (Compositae-Tagetinae) and phyletic implications. *Rhodora* 64:2-15.
- STROTHER, J. L. 1969. Systematics of *Dyssodia* Cavanilles (Compositae: Tageteae). *Univ. Calif. Publ. Bot.* 48:1-88.
- URBATSCH, L. E., J. D. BACON, R. L. HARTMAN, M. C. JOHNSTON, T. J. WATSON, and G. L. WEBSTER. 1975. Chromosome numbers for North American Euphorbiaceae. *Amer. J. Bot.* 62:494-500.
- WHEELER, L. C. 1941. *Euphorbia* subgenus *Chamaesyce* in Canada and the United States exclusive of southern Florida. *Rhodora* 43:97-154, 168-205, 223-286.

#### GROWTH FORMS OF *LARREA TRIDENTATA*

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The population dynamics of *Larrea tridentata* have been of considerable concern to plant ecologists. Interest has centered around questions of geographical distribution (Shreve, 1942; Gardner, 1951; Yang, 1953; Rickard and Murdock, 1963; Beatley, 1974), spacing of individuals (Barbour, 1969a; Woodell et al., 1969; Wright, 1970), seed germination and seedling establishment (Knipe and Herbel, 1966; Barbour 1968; Sheps, 1973), and growth patterns (Spalding, 1904; Runyon,